

UNIVERSITY OF CALIFORNIA.

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 28.

Examinations of Tule, Marsh and Alkali Soils.

Tule and Marsh Soils.

It should be remembered that the tules of California are of two distinct kinds, viz.: the land of the salt or tide-water lands, and those which are not now reached by saline tide water, or fresh-water tules. Of the samples examined, No. 720, from Roberts' Island, belongs to the latter class, while the other two are of the salt-marsh character, as is shown by their high contents of soda.

No. 720.—*Sediment soil from Roberts' Island*, San Joaquin county. Sent by Mr. J. W. Ferris, of Stockton, on behalf of the Glasgow Land and Improvement Co. The sample is slate-colored when dry, darkens greatly in wetting, and shows visibly the remnants of vegetation contained in it. The coarser part of this was taken out by sifting before analysis. It is of fine texture, with very little coarse sand, all passing through the sieve of 1-50 inch meshes. On heating it gives off a peaty odor, and becomes quite light colored and somewhat coherent, showing a considerable amount of clay in its mass.

No. 213.—*Soil from Navato Meadows*, near San Rafael, Marin county. Sent on behalf of the same interest by Mr. Christensen, the local superintendent. This soil is of a whitish-gray tint, and contains many streaks of vegetable remains intermixed by the plow, it having been plowed once; appears to be more sandy than the Roberts' Island soil. Here, also, the undecomposed vegetable remains were removed by the 1-50 inch sieve, the analysis representing the fine earth passing through. The soil is of a slightly brackish taste, and yields to water a somewhat brownish tint, showing that it is in an acid condition, as usual in such soils. The analysis resulted as shown in the table below:

NO. 720—TULE SOILS.

	ROBERTS' ISLAND.	NAVATO MEADOWS.
Insoluble Matter.....	40.65	39.70
Soluble Silica.....	61.83	64.65
Potash.....	21.18	24.95
Soda.....	.63	1.84
Lime.....	.26	1.80
Magnesia.....	.43	.87
Br. Oxide of Manganese.....	2.18	2.77
Peroxide of Iron.....	.05	.14
Alumina.....	10.01	5.21
Phosphoric Acid.....	13.59	13.20
Sulphuric Acid.....	.06	.07
Water and Organic Matter.....	.09	.24
	10.53	10.15
Total.....	99.66	100.43
Humus.....	2.36	1.54
Available Inorganic.....	.57	.31
Hygrosop. Moisture.....	10.44	17.08
Absorbed at.....17° C		at 9° C

Taking into consideration the differences in location and condition, the two soils are not as unlike each other as might have been expected. The Navato soil shows by its high percentage of alkalies and of sulphuric acid (chlorine was not determined), the presence of the ingredients of sea water. Its potash percentage is extraordinarily high. Lime is in full supply, but phosphoric acid is only in moderate proportions, as in most California soils. Humus is, of course, in abundant supply, but is in an acid condition, requiring aeration, and would doubtless also be benefited by the use of some lime or marl. The high absorption of moisture is largely due to the presence of so much vegetable matter.

The Roberts' Island soil, being thoroughly leached by fresh water, has less of potash as well as of soda, but still a full supply of the former. In lime it falls below the soils of the valley at large, much of it having, doubtless, been washed away in solution; and an addition of lime to the soil would doubtless be effective in moderating the "running-to-weed" which is noticeable in these lands, and is explained by the heavy supply of active humus, and therefore of nitrogen. But the phosphates are again only in somewhat scanty supply, and will doubtless be the first want felt in cultivation. For the present these lands are understood to be profusely fertile, sometimes embarrassing the farmer by the heavy stalks of the grain, in regard to the coarseness of his hay.

No. 787.—*Marsh soil from Grizzly Island*, Sacramento County, sent by Mr. Warren Dutton for examination as to its being sufficiently substantial to become a soil when cultivated. The soil resembles that from Navato meadows, but contains a much larger proportion of vegetable matter, and is very spongy. After drying at 100° it lost 29.7 per cent on ignition, showing that the surface to the depth to which the plow can reach is composed to the extent of nearly one-third of its weight, and quite half of its bulk, of undecomposed vegetable substance. It is, therefore, almost too much of a "muck" to be directly available for cultivation in its present condition.

Alkali Salts from the "wire-grass land" near Visalia, Tulare county. Leached from a sample taken in the wooded flats two miles west of Visalia (soil No. 585; see Report Coll. of Agr. for 1882, P. 26). This soil is a very productive one, and the analysis shows unusually high percentages of potash, lime and phosphoric acid. It being quite light in texture, the alkali does not interfere with its tillage, although the black rings it leaves upon evaporation of puddles of water standing on the soil show that it contains a large amount of carbonate of soda. The soil was extracted with water, which dissolved 1.20 per cent of its weight. On ignition it lost about two-fifths, or .50 of organic matter (dissolved humus); and of the remaining .76 per cent, .51 was again soluble in water, leaving .25

of insoluble residue consisting mainly of carbonate of lime, with a little magnesia, as well as some iron and alumina (perhaps simply a little clay).

The soluble part, the "alkali" proper, was composed as follows:

ALKALI SALTS FROM NEAR VISALIA.	
	Per cent.
Carbonate of Soda.....	45.3
Carbonate of Potash.....	13.8
Chloride of Sodium (common salt).....	4.4
Sulphate of Magnesia (Epsom salt).....	8.1
Tri-Phosphate of Soda.....	10.4
Sulphate of Soda (Glauber's salt).....	13.4
	100.4

It thus appears that of the soluble part of this alkali, nearly two-thirds (64.1 per cent) consists of carbonates, which therefore in the original soil would constitute .32 per cent of the weight of the soil, including nearly .10 of potassic carbonate (saleratus). The total of potash found in the original soil is 1.224 per cent, a very unusually high percentage. It is therefore quite clear that no potash manures will be needed in this soil for a generation at least; and so long as phosphate of soda circulates in the soil water, no bone meal will be called for. When this soil shall have been freed from its alkaline carbonates by the use of gypsum, it must become one of the most profusely fertile in the State.

Alkaline Efflorescence, from soil on Kern Is-

land, sent by Mr. Isaac B. Rumford, Bakersfield, February 27th, 1883. The crust yields to water 21.15 per cent. of soluble salts, the solution upon evaporation and ignition of the residue gives:

	Per Cent.
Again Soluble.....	94.94
Insoluble.....	1.70
Organic Matter and Water.....	3.34

The soluble part is composed as follows:

Sulphate of Soda.....	70.61
Carbonate of Soda.....	14.82
Chloride of Sodium.....	4.13
Sulphate of Potash.....	4.72
Carbonate of Magnesia.....	.45
Total Soluble.....	94.73

INSOLUBLE PART:

Carbonate of Lime.....	.58
Carbonate of Magnesia.....	.17
Sulphate of Lime.....	.08
Iron Oxide and Alumina.....	.32
Silica.....	.55

Total Insoluble.....1.70

This "alkali" is accordingly of the milder sort, containing only a relatively small proportion of the noxious carbonate of soda. This explains why the crops on Kern Island can succeed in spots on which, at times, the white efflorescence can be bodily scooped off. Yet the transformation of the carbonate of soda, by the use of gypsum on the soil, would be an undoubted improvement. E. W. HILGARD.